Appendix A
Remedial Investigation Field Procedures

APPENDIX A

Remedial Investigation Field Procedures

Task 3b—Surface Soil Sampling

The purpose of this task was to characterize the impact on soil in both residential and non-residential areas of Winkelman and Hayden by ASARCO operations.

Gamma Ray Survey Overview

The purpose of completing the gamma ray survey was to characterize gamma emissions from soils in and around the ASARCO property and the towns of Hayden and Winkelman, Arizona. The results of the survey were used for two main purposes: (1) screening radioactive levels for protecting the health and safety of the sampling crews; and(2) locating areas where gamma radiation may exist at levels higher than background.

A gamma ray survey was conducted at the site on January 23, 2006. This investigation employed the Ludlum 2221 rate meter (rate meter) and Ludlum 44-10 scintillator meter (detector) to survey gamma emissions from soil in and around Hayden and Winkelman. The selected areas surveyed are designated in the remedial investigation (RI) technical work plan and included Power House Wash (PHW), Kennecott Avenue Wash, State Route 77 in the vicinity of Hayden and Winkelman, portions of the Copper Basin Railway, the stormwater impoundments, and Gila River floodplain downgradient of the slag pile. These areas were selected because of their proximity to areas assigned for sediment and soil sampling.

Field Activities

CH2M HILL conducted the gamma ray survey on January 23, 2006. In addition to CH2M HILL sampling staff, Bill Loehr from ASARCO provided oversight for the areas located within ASARCO.

The survey was completed by walking in random serpentine patterns across or along the target areas while holding the detector approximately 0.5 to 3 inches above the ground, and while carrying the portable rate meter in the other hand so the meter could be easily read. The field personnel kept an even slow pace during the survey to maintain consistency. Some areas traversed by the field personnel were limited by vegetation, terrain, and ore processing activities.

The survey locations along State Route 77 within Winkelman and along the Copper Basin Railway were performed differently than described above. Because of safety and access issues in these areas, the field personnel remained in the field vehicle to conduct the survey, while holding the detector out of the passenger side window approximately 1 to 3 inches above the ground. The driver kept the truck speed as slow and steady as possible along the shoulder of the road and railway access roads.

If the rate meter detected a gamma-emission value higher than the background range, the field personnel returned to the spot and held the detector in the vicinity for 60 seconds in an attempt to duplicate the high value. Only a few locations had gamma emissions at levels higher than background. However, when counts were verified at these locations, the field personnel were unable to duplicate the previously observed value.

Phase I Soil Sampling Overview

The Phase I soil sampling activities were conducted at the site from November 15 through November 18, 2005, in accordance with the RI technical work plan. The Phase I investigation involved performing both field portable X-ray fluorescence (FPXRF) and laboratory analyses of samples collected from 30 sample locations within San Pedro Wash (SPW) and PHW. These two areas were selected for sampling to test the performance of the FPXRF under two distinct conditions. SPW is located in an area considered unlikely to have been significantly affected by ASARCO operations. Conversely, PHW is located directly downslope of ASARCO operations and was thus considered more likely to contain increased metal concentrations in soils.

Field Activities

In addition to the CH2M HILL staff, Bill Loehr from ASARCO provided oversight throughout the sampling event.

Sample Location Selection

Sample locations were selected within SPW and PHW using a grid system with a sample spacing interval of approximately 300 feet. The coordinates for the sample locations were preliminarily selected before conducting the fieldwork using a geographic information system (GIS). These coordinates were then loaded onto a Trimble® GeoXT™ handheld geographical positioning system (GPS) to navigate the field crew to the appropriate sampling locations. Some of the predetermined sample points were located on ridges topographically above their associated channels, where there was little to no sediment to be sampled. As a result, these sample locations were moved to areas within the channels where sediments were more abundant.

Sample Collection Procedures

Before collecting Phase I surficial soil samples in SPW and PHW, an area of approximately 12-24 inches in diameter was cleared of all surface vegetation and debris at each location. With the field crew wearing fresh nitrile gloves, a decontaminated stainless steel spoon was used to collect the surficial soil sample to a depth of 2 inches. The sample was then placed into a 2.5-gallon plastic bag and homogenized. Subsurface samples were collected at most locations where the surficial soil exceeded five times the residential soil remediation level (R-SRL) for arsenic, copper, and/or lead. These samples were collected using a decontaminated stainless steel hand auger advanced to a depth of 10-12 inches below ground surface (bgs).

Fifteen (15) discrete samples were collected from 15 locations in SPW and 20 discrete samples were collected from 15 locations in PHW, including five subsurface soil samples in PHW. Quality Assurance/Quality Control (QA/QC) samples were collected in accordance with the Quality Assurance Project Plan (QAPP), including one field duplicate sample and one matrix spike/matrix spike duplicate (MS/MSD) sample in SPW and two field duplicate samples and one MS/MSD sample in PHW.

CH2M HILL recorded soil characteristics and documented each sample location photographically in accordance with the Field Sampling Plan (FSP).

Field Measurement

An FPXRF was employed to measure metals in the field using the “Bulk Mode” setting. The Niton instrument (Serial #XL700-U1810MU568) was calibrated each day before use, followed by intermittent calibrations throughout the day using the “self check” function. To avoid potential drift in the detector, the instrument was allowed to warm up in excess of the manufacturer’s recommended time of 15 to 30 minutes. The FPXRF was used to measure concentrations of several metals believed to be potentially present in SPW and PHW sediments, including arsenic (As), cobalt (Co), chromium (Cr), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), rubidium (Rb), strontium (Sr), zinc (Zn), and zirconium (Zr).

Two FPXRF readings were taken for each sample for a duration of approximately 100 nominal seconds. The first reading was taken directly from the bag after the sample was homogenized, while the second reading was taken in the manufacturer-supplied sample cup, using the fraction of the soil sample that passed through a #10 (2 millimeter [mm]) sieve.

Information generated by the FPXRF analyzer, including detected concentrations of arsenic, copper, and lead (the primary metals of interest) was recorded on a sample tracking form to track each sample. Additional information recorded on the sample tracking form included the sample ID, longitude, latitude, date, time, and applicable QC samples.

Sample Management

All surficial soil samples were handled in accordance with the FSP. Homogenized samples were taken directly from the collection bag and placed into two 8-ounce jars and one 4-ounce jar; one of the 8-ounce jars was given to Bill Loehr as a split for possible analysis by ASARCO. The other two sample jars were labeled with the sample ID, date, time, appropriate analysis (target analyte list [TAL] metals + Br + Mo for the 8-ounce jar and Total Organic Carbon [TOC] + pH + percent solids for the 4-ounce jar), case number and client ID. A custody seal was placed over each sample container cap and the jars were placed into coolers containing double-bagged ice and a temperature blank. A chain of custody (COC) was then placed inside each sample cooler and custody seals were affixed to the outside of each cooler before shipping. The coolers were then shipped via FedEx to the appropriate laboratory designated by United States Environmental Protection Agency (EPA).

Residential Soil Sampling

The Phase II residential soil sampling was performed in accordance with the RI technical work plan and Addendum #1. Residential yards of 130 habitable homes within Hayden and Winkelman were included in the Phase II investigation.

Field Activities

CH2M HILL conducted Phase II residential surficial soil sampling at the site between January 30, 2006, and February 17, 2006. In addition to CH2M HILL sampling staff, EPA provided in-field oversight throughout the sampling event.

Designation of Sample Zones

Sample locations were selected within the town limits of Hayden and Winkelman based on the potential human risk of exposure to metals. To aid with this process, Hayden and Winkelman were divided into 26 separate zones (Figures 3-1 and Figure 3-2). These zones were then separated into two categories termed Category 1 and Category 2. Category 1 includes areas in close proximity to smelter operations, which have a greater potential to be affected by aerial deposition, surface water runoff, or waste disposal activities, while Category 2 includes areas more distant from smelter operations, which are likely to be affected primarily by aerial deposition. Because Category 1 could have more deposition patterns, at least 30 percent of all residential lots in zones from this category were sampled. Category 2 represents a less irregular deposition pattern than Category 1, so a correspondingly lower sample frequency of at least 15 percent was employed in these zones.

Parcel Selection and Access Agreements

Parcels were chosen for sampling only if a signed access agreement was obtained from the property owner or tenant. Property ownership information was gathered from the Gila County tax rolls and access agreements were sent to all residential property owners within Hayden and Winkelman. Property owners or tenants were asked to complete, sign, and return the access agreements. A database was prepared to track access agreements, showing when agreements were sent and received. In instances where an insufficient number of access agreements were received in a given zone, residents were approached directly to sign an access agreement. Before conducting sampling at a given parcel, the resident of the property was notified and a fact sheet developed by EPA was provided to the resident to explain the sampling program.

Sample Collection Procedures

A total of 10 surface samples were collected on each residential lot. Of these, 9 surface soil samples (collected from 0-2 inches bgs and denoted "A through I" locations) were collected in each residential lot and included areas such as downspouts, gardens, play areas, and other high-use locations within the yards. The remaining subsurface sample was collected at 10-12 inches bgs and denoted "J" location, The laboratory analyzed all samples for TAL inorganics (EPA 160mod), TOC (ASTM D 4839), and pH (EPA 9045). Unbiased FPXRF duplicate QA/QC samples were collected and analyzed in the field at the "A" location in each yard (one QA/QC sample per yard). Soil characteristics were documented at each sample location using field data sheets and photography in accordance with the FSP.

Before collecting Phase II residential surficial soil samples, an area of approximately 12-24 inches in diameter was cleared of all loose vegetation and debris. With the field crew wearing fresh nitrile gloves, a decontaminated stainless steel spoon was used to collect the surficial soil sample to a depth of 2 inches bgs. The sample was then placed into a 1-gallon plastic bag and homogenized by turning the bag over and over for at least 10 repetitions.

Subsurface samples were collected using a decontaminated stainless steel hand auger advanced to a depth of 10-12 inches bgs.

Field Measurement

Two FPXRF instruments were employed to measure metals in the field using the "Bulk Mode" setting. The Niton instruments (Serial #'s XL700-6801 and XL700-8608) were calibrated each day before use, followed by intermittent calibrations throughout the day using the "self check" function in addition to using sample SPW-01 from the Phase I soil sampling event conducted in November 2005. Sample SPW-01 was used in the calibration self-check process for two reasons: (1) the sample was analyzed by the laboratory, and as a result, the arsenic concentration was known and was at a mid-level concentration range based on Phase I sampling results; and (2) the sample was used extensively in the site-specific calibration conducted in January 2006 before mobilizing for the Phase II sampling effort. In the event the FPXRF instruments did not detect arsenic in sample SPW-01 at a concentration of 28 parts per million (ppm) ± 6 ppm, the instruments were restarted and allowed to self-calibrate again. To avoid potential drift in the detector, the instrument was allowed to warm up in excess of the manufacturer's recommended time of 15 to 30 minutes.

The FPXRF instruments were used to measure concentrations of several metals believed to be potentially present in Hayden and Winkelman sediments, including arsenic, cobalt, chromium, copper, iron, manganese, molybdenum, nickel, lead, rubidium, strontium, zinc, and zirconium. The samples were analyzed in the instrument chamber using the manufacturer-supplied cups and mylar covers for 120 nominal seconds. To maintain consistency, in-chamber analysis for both FPXRF instruments was employed.

Information generated by the FPXRF analyzer, including detected concentrations of arsenic and copper, was recorded on the field data sheet to track each sample. Additional information recorded included the sample ID, longitude and latitude (using a handheld GPS unit), date, time, applicable QC samples, lithologic descriptions, and a sketch of the associated sample area.

Sample Management

All surficial soil samples were handled in accordance with the FSP. Samples collected for laboratory analysis were taken directly from the collection bag and placed into one 8-ounce polyethylene jar and one 4-ounce glass jar. The two sample jars were labeled with the sample ID, date, time, appropriate analysis (TAL metals + Br + Mo for the 8-ounce jar and TOC + pH + percent solids for the 4-ounce jar), case number, and client ID. A custody seal was placed over each sample container cap and the jars were placed into coolers containing double-bagged ice and a temperature blank. A COC was then placed inside each sample cooler and custody seals were affixed to the outside of each cooler before shipping. The coolers were then shipped via FedEx to laboratories assigned by EPA, including Liberty Analytical (a Contract Laboratory Program [CLP] facility selected for analysis of TAL inorganics) and the EPA Region IX Laboratory (for analysis of TOC, pH, and percent solids).

Deviations from Work Plan

The RI technical work plan identified the following analyses to be conducted on soil samples during the investigation: TAL metals, cation exchange capacity, percent solids, grain size distribution, pH, and TOC. EPA removed cation exchange capacity and the grain size distribution analysis because they were considered not to be important with respect to contaminant distribution.

Nonresidential Soil Sampling

The Phase II nonresidential soil sampling involved performing laboratory analyses collected from 238 sample locations in and around the site, including 105 samples collected at 87 locations on ASARCO property, and 133 samples taken at 118 locations from surrounding areas. The following areas were targeted and sampled during this investigation:

1. Former Kennecott smelter area, including smelter yard, smelter Last Chance Pond, and the slag dump.
2. Kennecott Avenue Wash and the conveyor wash area, including side slopes adjacent to the washes and extending to the limit of residential yards.
3. Soils in the vicinity of the crusher facility and on the western side of the concentrator facilities.
4. Soils adjacent to public areas in Hayden.
5. Developed land adjacent to the Copper Basin Railway and State Route 177 (north of Tailings Impoundment AB/BC) and extending along the main highway through Winkelman.
6. Dust associated with No. 9 Conveyor.
7. Winkelman school areas.
8. Hayden Golf Club property and access road east of Tailings Impoundment AB/BC.
9. Drainage areas immediately downstream of the slag dump located southeast of the active smelter.
10. Upland areas representing different wind directions.

Sample Location Selection

Sample locations were selected within and outside the town limits of Hayden and Winkelman based on the potential human risk of exposure to metals by a variety of routes. Sample locations were chosen for each area as described below:

1. ASARCO property, including the former Kennecott smelter area, Kennecott Avenue Wash, crusher facility, developed land adjacent to the railway, dust associated with No. 9 Conveyor, and the drainage areas immediately downstream of the slag dump located southeast of the active smelter.

   Samples were taken from 79 locations located within and near the ASARCO property. These locations included the crusher facility (7), Kennecott Avenue Wash (10), former Kennecott smelter (15), perimeter of the concentrator (28), perimeter of the smelter (1), the slag dump (1), south of the slag dump (4), and around the tailings impoundments (13).

2. Winkelman School Complex, including staff housing on school property. Thirty-eight (38) samples were collected around the school buildings, athletic fields, and playgrounds. An additional 31 samples were collected around three residential school-owned properties on Lobo Lane, adjacent to and west of the school complex.

3. Hayden Public Golf Club and access road east of Tailings Impoundment AB/BC. Thirty-five (35) samples were collected from 33 locations at the Hayden Public Golf Club.

4. Upland areas representing different wind directions and along State Route 177 (north of Tailings Impoundment AB/BC) and extending through Winkelman). A total of 55 samples (including 26 upland samples) were taken in areas within and adjacent to Hayden and Winkelman. Surface and subsurface samples were taken in the upland areas to help further evaluate background conditions, where possible, and in other areas where elevated arsenic levels were found in the surficial soils. These locations included areas west of Hayden, north of Hayden, south of Winkelman, between the slag piles, and south of the slag piles.

Sample Collection Procedures

The sample collection procedures were in general accordance with the RI technical work plan and Addendum #1. Before collecting Phase II nonresidential soil samples, an area of approximately 12-24 inches in diameter was cleared of all vegetation and debris. With the field crew wearing fresh Nitrile gloves, a decontaminated stainless steel spoon was used to collect the surficial soil sample to a depth of two inches. The sample was then placed into a 1-gallon plastic bag and homogenized by turning the bag over and over for at least 10 repetitions. Subsurface samples were collected using a decontaminated stainless steel hand auger advanced to a depth of 10-12 inches bgs.

A total of two (one surface and one subsurface) samples were collected at each Hayden public park/playground (designated "HPUB") location, upland (UP and UPA) location (where physically possible), and at most locations where a surface sample exceeded 80 ppm of arsenic as measured initially by the FPXRF. At all other locations, one surface soil sample was collected. All samples was sent to the laboratory for analysis of TAL inorganics (EPA 160mod), TOC (ASTM D 4839), and pH (EPA 9045). Soil characteristics were documented each sample location using field data sheets and photography in accordance with the FSP.

Field Measurement

Two FPXRF instruments were employed to measure metals in the field using the "Bulk Mode" setting. The same Niton instruments (Serial #'s XL700-6801 and XL700-8608) from residential sampling event were used during the nonresidential sampling event. The field measurement activities were as described for the residential soil sampling event.

Sample Management

All surficial soil samples were handled in accordance with the FSP. Samples collected for laboratory analysis were taken directly from the collection bag and placed into two 8-ounce polyethylene jars and one 4-ounce glass jar. One of the 8-ounce jars was given to the

ASARCO representative as a split for possible analysis by ASARCO. The two remaining sample jars were labeled with the sample ID, date, time, appropriate analysis (TAL metals + Br + Mo for the 8-ounce jar and TOC + pH + percent solids for the 4-ounce jar), case number, and client ID. A custody seal was placed over each sample container cap and the jars were placed into coolers containing double-bagged ice and a temperature blank. A COC was then placed inside each sample cooler and custody seals were affixed to the outside of each cooler before shipping. The coolers were then shipped via FedEx to Liberty Analytical (TAL inorganics and TAL metals) and the EPA Region IX Laboratory (TOC, pH, and percent solids).

Supplemental Sampling event overview:

The objective of this sampling event was to supplement the Phase 2 residential soil data by submitting additional soil samples, retained in storage, for laboratory analysis. Per EPA direction, samples from a residential lot will be submitted for laboratory analysis if the soil sample(s) submitted for CLP arsenic, and/or the 95% UCL for FPXRF arsenic, exceed 39 mg/kg. The 39 mg/kg value equals 10^{-4} risk per the EPA Region IX preliminary remediation goal (PRG) algorithm. To evaluate any concentration differences due to exceedance of the 6-month hold time, one sample from each lot will be submitted for laboratory analysis.

Field Activities:

CH2M HILL staff conducted the field activities beginning on November 20, 2006 through November 28, 2006.

Sampling Procedures:

Every parcel will have up to ten samples plus one field duplicate sample submitted for laboratory analyses. One sample from every two parcels (or one per 20 samples) will have a sample designated as MS/MSD. Samples will be analyzed for CLP TAL inorganics (AS, Pb, and Cu only) and percent solids.

Samples to be submitted for laboratory analysis will be from those retained at the Tempe, AZ secure storage location. The following steps will be followed:

- Set up table, cover with plastic sheeting, and don nitrile gloves.
- Take out all soil samples from one parcel ID at a time (up to ten samples) from soil stored in boxes.
- Thoroughly homogenize each sample by rotating bag 7 to 10 times.
- If bag is compromised or will not shut, place soil in a new bag and homogenize.
- If there is not enough sample or if sample is missing for the CLP re-analysis (RE) samples, take sample from jar stored in cooler, place in new bag, and homogenize.
- After homogenizing, scoop sample from bag with new disposable scoop and fill 4-ounce jar half full (two ounces), making sure the grain size is relatively uniform with no large particles.
- For samples requiring MS/MSD, submit two jars per sample.
- Change gloves between each sample.
- Change plastic sheeting as needed if it comes into contact with spilled soil.

Sample Management and Documentation

Field Logbooks

The primary soil sample handling activities will be recorded in a bound field notebook. These notebooks are intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project. Entries must be dated, legible, written in permanent ink, and contain accurate and inclusive documentation of project activities. Language should be objective and factual. Legible corrections, which will be single lines through the error, signed and dated by the person making the correction. The field notebook must be maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Entries should be signed and dated. It should be kept as a permanent record.

Labeling

Each sample container will be labeled with a sample identification number, date of collection, time of collection, case number, type of analysis, and preservatives (in this case, no preservatives are needed). Sample identification numbers and locations (including MS/MSDs and duplicates) will be recorded in the field notebook and field datasheet.

Chain of Custody Procedures

When samples are shipped to the laboratory, they must be placed in containers sealed with custody seals. One or more custody seals must be placed on each side of the shipping container (cooler). COC forms will be filled out or generated using Forms II Lite for the collected samples as applicable.

COC procedures will be followed as described below to accomplish this task:

- The COC documentation will be completed using the information included on each sample label including a sample identification number which will correspond to the sample site, The inorganic sample number, the date and time the sample was collected, case number, identification of any preservatives used, and the analysis requested.
- Additional information included on the COC will include the date shipped, carrier name, Airbill number and laboratory mane, address and telephone number, samples to be used for laboratory QC and any special instructions or warnings for the laboratory.
- Each COC form will be signed by the sampler, additional sampler, and again be signed by the laboratory official once the samples have been delivered. Courier names and other pertinent information are entered in the “Received by” section of the COC record.
- The COC will be included with each sample it documents until such time the samples have been delivered to the laboratory. The original COC accompanies the shipment to the laboratory. One copy of the COC will be retained in the project file, and another copy along with the archived database, will be sent to EPA.

If sent by mail, the package is registered with return requested. If sent by common carrier, a bill of lading is used. Freight bill, postal service receipts, and bills of lading are retained as part of the permanent documentation.

Comprehensive Soil Sampling

The comprehensive soil sampling activities were conducted to supplement the Phase II soil data by submitting all remaining residential and non-residential soil samples retained in storage, for laboratory analysis that were not previously submitted. Samples were collected and sent to the lab from August 6 through September 14, 2007 in accordance with the RI technical Workplan Addendum #4. Selected samples that were previously analyzed by the laboratory were collected and re-analyzed to evaluate any concentration differences due to exceedance of the 6 month hold time. The comprehensive soil sampling investigation involved performing laboratory analysis of samples collected from 83 residential lots for a total of 793 samples, 186 non-residential locations, and 37 samples to evaluate holding times. A total of 1037 samples were collected and analyzed. All samples were analyzed for CLP TAL inorganics (As, Pb, and Cu only) and percent solids.

Field Activities.

CH2M HILL staff conducted the field activities beginning on August 6, 2007 through September 14, 2007.

Sample Location Selection.

All remaining residential and non-residential samples not previously submitted were set for laboratory analysis.

Sample Collection Procedures.

Soil samples were retained in storage in Ziploc baggies at the Tempe, Arizona secure storage location (EPA storage shed). The following procedures for collection were followed:

1. Set up table, cover with plastic sheeting, don nitrile gloves.
2. Take out all soil samples from one parcel only at a time from soil stored in baggies and boxes.
3. Thoroughly homogenize each sample by rotating bag 10 times.
4. If bag was compromised or would not shut, it was placed in a new bag and homogenized.
5. After homogenizing, samples were scooped from the bag with a new disposable pre-cleaned scoop. Samples were placed into a 4-ounce pre-cleaned and certified high-density polyethylene (HDPE) bottle. The bottle was filled with approximately 2 ounces. Grain sizes were kept relatively uniform.
6. Samples requiring MS/MSD analysis had two bottles submitted for per sample.
7. Gloves were changed between each sample.
8. Plastic sheeting was changed or wiped down with hand wipes as needed or if it came into contact with spilled soil.
9. A signed and dated custody seal was placed around the lid of soil sample bottle.
10. Bottles were placed in coolers with ice, securely sealed, a COC was placed inside the coolers and they were shipped.

Field duplicate samples were submitted for laboratory analyses at a 10% rate. One sample from every 20 had a sample fraction designated as MS/MSD.

CH2M HILL recorded samples used for duplicates and MS/MSD in a field book.

Sample Management.

The primary soil sample for duplicates and MS/MSD was recorded in a bound field notebook. These notebooks were used to provide sufficient data and observations to enable participants to reconstruct events that occurred during the sampling event.

Each sample container was labeled with a sample identification number, date of collection, time of collection, case number, type of analysis, and preservative (4 degrees Celsius only). Chain of Custody procedures given in the RI technical workplan Addendum #4 were followed. Before shipping, samples were compared against the COC for accuracy.

Following the submittal of each sample set, the COC was properly filed (electronic and hard copy, and a copy provided to the data manager to verify all information was correct.

Task 3c—Surface Water and Sediment Sampling

This task had two key purposes: (1) complement results of previous investigations and develop a better understanding of contaminant levels, potential contaminant sources, and contaminant migration patterns over a broader area; and (2) collect sufficient data to support remedial actions, if necessary. Data collected from surface water and sediment sampling supported a screening-level ecological risk assessment (ERA).

Field Activities

Combined surface water and instream sediment sampling was conducted on March 7 and 8, 2006, (winter event) and on August 22 and 23, 2006 (summer event). The required 48-hour advance notice for sampling was given to ASARCO on March 2, 2006, and August 18, 2006. In addition to CH2M HILL sampling staff, a representative from ASARCO provided oversight throughout the sampling event.

Soil sampling from riparian communities was conducted adjacent to the Gila and San Pedro Rivers on April 27 and 28, 2006. The required 48-hour advance notice for sampling was given to ASARCO on April 21, 2006. CH2M HILL staff, ASARCO, U. S. Fish and Wildlife Service (USFWS), and Arizona Game and Fish Department (AGFD) were present during portions of the sampling event.

Sample Location Selection

The combined surface water and in-stream sediment sample locations were selected along the Gila and San Pedro Rivers based on the potential ecological and human risk due to exposure to site-related contaminants by a variety of routes. Location selection was also based on potential source areas, the location of riparian habitat based on aerial photo review, geographic constraints, property ownership constraints, and personnel access constraints. Sample locations were chosen along the Gila River upstream of main site operations, upstream of the slag pile, downstream of the slag pile, upstream of the San

Pedro River confluence, downstream of the San Pedro River confluence, south of Tailings Impoundment AB/BC, between Tailings Impoundments AB/BC and D, southwest of Last Chance Basin, and downstream of site operations to a distance of approximately 5 miles past Last Chance Basin. For the combined surface water/in-stream sediment samples, the 11 locations along the Gila River were designated GR-1 through GR-11, while the two locations along the San Pedro River were designated SPR-1 and SPR-2.

The stable and unstable riparian sediment samples were collected in the nearest suitable habitat adjacent to the 11 Gila River locations and the two San Pedro River locations. In addition, five additional biased sample locations in the Gila River floodplain (between the confluence of the San Pedro River and Last Chance Basin, and designated GR-12 to GR-16), were selected for collection of stable and unstable riparian soil samples.

Sample Collection Procedures

The surface water and in-stream sediment sampling activities were collected concurrently at approximately the same location. The riparian soil samples were collected at the nearest suitable habitat to the combined surface water/in-stream sediment sample locations, and at the five additional biased sample locations. A Trimble® GeoXT™ GPS was used to identify each sampling location during both combined sampling events and during the separate riparian soil sampling event.

Surface Water Samples

Before collecting surface water samples, two new 500-milliliter bottles were rinsed three times with river water. Samples were then collected by holding the bottles underwater with the opening facing downstream. When preserved bottles were employed, water was decanted into the preserved bottles using a new bottle each time as a transfer vessel. The field-filtered sample was pumped from the collection bottle through Masterflex® tubing and a 40-micron filter using a multi-speed Geopump II peristaltic pump. New collection bottles, tubing, and filter were used for each sample. The ASARCO representative took samples in conjunction with CH2M HILL at a distance of approximately 15 feet downstream from CH2M HILL.

In-Stream Sediment Samples

Each sediment sample was collected using a clean (decontaminated) stainless steel spoon. The spoon was used to scrape sediments off the channel bed and place them into two clean (new) ziplock plastic bags. Water was allowed to drain from the samples by tipping the ziplock bag and allowing the water to drain through the partially opened bag. One bag was given to the ASARCO representative, while sediment from the other bag was homogenized and placed into sampling jars. The samples were homogenized by turning the ziplock bag over end-to-end 10 times, or in the case of clay, by kneading the bag for 3 minutes. Spoons were then decontaminated using a bottle brush and an Alconox/distilled water (DI) mixture. Once the spoons were thoroughly scrubbed, they were rinsed with DI water and allowed to air-dry by resting on paper towels in a clean, 5-gallon bucket. The decontamination liquids were dispensed from two garden type polyethylene sprayers, insuring that no contaminated water was used on the spoons.

Riparian Soil Samples

Each sample was collected using a clean (decontaminated) stainless steel spoon. The spoon was used to scrape shallow soils and place them into two clean (new) ziplock plastic bags. One bag was given to the ASARCO representative, while soil from the other bag was homogenized and placed into sampling jars. The samples were homogenized by turning the ziplock bag over end-to-end 10 times, or in the case of clay, by kneading the bag for 3 minutes. Spoons were then decontaminated as described above for the instream sediment samples. QA/QC samples were collected and analyzed in accordance with the QAPP.

For all sampling activities, field parameters were recorded and documented each sample location using a field logbook and photography in accordance with the FSP.

Field Parameter Measurements

Field parameters were collected for surface water samples, including pH, specific conductance, temperature, turbidity, and dissolved oxygen. This information was recorded in a field logbook.

Deviations from Work Plan

The RI technical work plan identified surface water samples to be taken from the ponds on top of Tailings Impoundments AB/BC and D. However, samples were not taken at these locations due to access and safety constraints. Evaluation was done on whether it would be possible to obtain a sample of tail water from the concentrator operations, but this was not possible since a sample port did not exist. Total and dissolved boron were not analyzed during the March 2006 surface water sampling event, and total suspended solids (TSS) and TDS were not analyzed during the August 2006 surface water sampling event.

Sample Management

All surface water and sediment samples were handled in accordance with the FSP, as summarized below.

Surface Water

Before collecting surface water samples at a given location, all sample bottles were labeled with the sample ID, date, time, appropriate analysis, preservative, case number, and client ID. Samples were marked for analyses of TAL inorganics; cyanide (CN); TDS; TSS; TOC; alkalinity; ammonia (NH_3); and hardness (preserved with nitric acid). A custody seal was placed over the cap of each sample container and the bottles were placed into coolers containing double-bagged ice and a temperature blank. A COC was then placed inside each sample cooler and custody seals were affixed to the outside of each cooler before shipping. The coolers were then shipped via FedEx to the designated laboratories. Sample aliquots were sent to the EPA Region IX Laboratory for analysis of TDS, TSS, TOC, alkalinity, ammonia, and hardness (four bottles per sample). Sample aliquots for TAL inorganics and cyanide (two bottles per sample) were sent to Liberty Analytical (the assigned CLP laboratory) in Cary, North Carolina.

In-Stream Sediment and Riparian Soil

The in-stream sediment and riparian soil samples collected for laboratory analysis were taken directly from the ziplock collection bag and placed into two jars using a decontaminated stainless-steel spoon. One 8-ounce plastic jar was used for sediment/soil to be analyzed for TAL inorganics and one 4-ounce glass jar was used for sediment/soil to be analyzed for TOC, pH, and percent solids. The two sample jars were labeled with the sample ID, date, time, appropriate analysis, case number, and client ID. A custody seal was placed over each sample container cap and the jars were placed into coolers containing double-bagged ice and a temperature blank. A COC was then placed inside each sample cooler and custody seals were affixed to the outside of each cooler before shipping. The coolers were then shipped via FedEx to the designated laboratories. Sample aliquots were sent to the EPA Region IX Laboratory for analysis of TOC, pH, and percent solids. Sample aliquots for TAL inorganics and cyanide were sent to Liberty Analytical in Cary, North Carolina.

Task 3d—Groundwater Investigation and Sampling

The purpose of installing new monitoring wells GW-01, GW-02 and GW-06 was to compliment existing wells and evaluate shallow groundwater quality impacts, which may occur in the source areas upgradient of these areas and to evaluate potential discharge to the Gila River alluvium from the site. For the installation of monitoring well GW-03 in proximity of the Hayden wellfield, the purpose was to complete regional groundwater elevations and serve as an observation well for the nearby production wells if refinement of aquifer hydraulic parameters is needed. The purpose for the two groundwater sampling events was to evaluate the nature and extent of possible contamination within and around the site.

Drilling and Monitoring Well Installation

Four monitoring wells (GW-01, GW-02, GW-03, and GW-06) were installed by WDC Exploration & Wells between January 4, 2006, and January 12, 2006. A fifth monitoring well, GW-01(R), was installed during the week of August 7, 2006, to replace GW-01. This work was performed in accordance with the *Final Work plan, Remedial Investigation at the ASARCO LLC Hayden Plant Site, Hayden, Gila County, Arizona* (RI Technical Work plan, CH2M HILL, September 2005), *Task 3d – Groundwater Investigation and Sampling*.

All locations were drilled on ASARCO property and installed with aboveground locking surface completions with concrete pads. GW-01 and GW-01(R) were installed east of Kennecott Road, just south of Utah Street. GW-02 was installed downgradient of the slag pile off of State Route 77. GW-03 was installed between the Tailings Impoundment AB/BC and the Hayden wellfield. GW-06 was installed in PHW near the former bridge abutment.

At each initial well location, WDC advanced a 12-inch-diameter steel solution casing to 10 feet bgs and grounded this into place with cement/bentonite slurry. Then, 8-inch-diameter boreholes were advanced at each location with Air Rotary Casing Hammer (ARCH) techniques utilizing a Speedstar SV-CH drill rig. ARCH advances temporary steel casing in conjunction with a conventional air rotary drill string. The drill cuttings were directed from a cyclone to a roll off container staged at each drill site. When the target depth of each well was reached (a sufficient depth below the observed water table to support a well), the drill string was removed, the well built inside the temporary casing, and the temporary casing removed. Well GW-01 was installed by WDC on August 8 and 9, 2006, using hollow-stem auger methods, and air rotary methods at a depth where more competent material was encountered.

Boring logs for each monitoring well are presented in Appendix A**.** The following sections summarize the procedures for drilling and construction of each monitoring well.

Soil Sampling During Monitoring Well Installation

Soil samples were collected from cuttings obtained at 5-foot intervals. The samples were collected and placed in resealable bags and labeled for future reference. The samples were classified in accordance with the Unified Soil Classification System (USCS). Lithologic observations were recorded on CH2M HILL's standard boring log.

The format and order for soil descriptions are as follows:

1. USCS soil name with appropriate modifiers.
2. Group symbol.
3. Color.
4. Moisture content.
5. Relative density or consistency.

Drilling and Logging

Five lithologic units were encountered during the drilling operations, including the following:

- Wash alluvium consisting of Holocene alluvium and artificial fill
- Tailings consisting of sands, silts, and clays
- Gila River alluvium consisting of Holocene and deeper Tertiary sediments consisting mainly of sand, gravel, and cobbles
- Big Dome Formation (bedrock) consisting of Tertiary age basin fill conglomerate
- Crystalline Igneous formation, possibly diabase

Four monitoring wells (GW-01, GW-01(R), GW-02, and GW-06) were installed within alluvial channels, such that the screen interval was located across the alluvium and partly into the conglomerate. One monitoring well (GW-03) was installed within the Gila River Wash alluvium, such that the screen interval was similar to the pumping wells in the vicinity.

Monitoring Well Construction

Monitoring well construction details were generally similar for all the monitoring wells except GW-01(R). Each monitoring well consisted of a 4-inch-inner-diameter schedule 80 polyvinyl chloride (PVC) well casing within the 8-inch-diameter borehole. Well screens were .020-inch slotted schedule 80 PVC varying from 20 feet to 30 feet in length. A filter pack of 6/9 sand was placed around the screen with a tremie pipe to a minimum of 2 feet above the screen. A second layer of #60 choker sand was placed on top of the filter pack. A bentonite seal was placed on top of the choker sand. The annulus was filled from the bentonite seal to the surface with a bentonite grout mixture. A locking aboveground steel surface casing was placed in the grout before it set and a concrete pad (2 feet in diameter) was built around the surface casing.

GW-01(R) deviates from the original monitoring wells such that it is a 2-inch-inner-diameter schedule 40 PVC well completed within a 6-inch-diameter borehole to 37 feet bgs, which transitions to a 4-inch-diameter borehole to total depth. All other well construction activities were similar to the description outlined above.

The screened interval for each monitoring well is as follows:

- GW-01: screen from 41 feet to 61 feet bgs
- GW-01(R): screen from 39 feet to 59 feet bgs
- GW-02: screen from 11 feet to 31 feet bgs
- GW-03: screen from 60 feet to 90 feet bgs
- GW-06: screen from 11 feet to 31 feet bgs

Table F-1 of Appendix F in this RI report shows the well construction details and the unit the monitoring well was screened in.

Monitoring Well Development

Monitoring wells were developed at least 24 hours after the completion of all grouting activities. Monitoring well development was conducted by swabbing with a surge block, bailing with a bailer, and surge purging with a submersible pump (where possible). Field staff described (in the field logbook) the development methods and equipment used during each step of the development process, and recorded relevant information on a well development form, including pumping rates and duration, frequency and duration of swabbing and surging cycles, and the volume of groundwater generated during each step of the development process.

Turbidity, electrical conductivity, pH, and temperature (field parameters) of the discharge water were monitored during development. Development continued until the field parameters were stable (for example, ±10 percent electrical conductivity, ±0.1 pH unit, ±10% temperature) and the turbidity had decreased to asymptotic levels. Field staff recorded this information on a well development form.

Ongoing Development Activities

Following the winter 2006 groundwater sampling event, GW-01 and GW-02 needed further development because of low yields, increased turbidity, and elevated pH levels. These monitoring wells continued to hand bail periodically over the course of several weeks. The efforts provided some improvements in water quality; however, WDC returned to the site on July 5 and 6, 2006, to provide more rigorous development. Procedures were similar to the descriptions outlined above, however, to facilitate development of the slowly recharging monitoring wells, a limited amount of potable water from the plant site was gravity fed down the monitoring wells to assist with swabbing and surge blocking.

GW-02 was successfully redeveloped and the pH lowered to a value more consistent with background values. The pH values for GW-01 were inconsistent, but remained generally high, and the well yield remained low. Therefore, WDC drilled and installed a new monitoring well in the vicinity of GW-01, and the replacement monitoring well is GW-01(R).

Deviations from Specifications

For monitoring well GW-03, during installation a bentonite seal was not placed between the sand and grout due to problems with the well casing and drive casing binding together. Alternately, a second bag of #60 transition sand was placed such that the top of the entire sand filter pack was 9 feet above the top of the slotted screen. The cement/bentonite grout was then emplaced from this depth (51 feet bgs) to ground surface.

During monitoring well GW-06 installation, the #60 transition sand was not placed between the bentonite seal and the 6/9 sand used for the filter pack. The 6/9 sand was 4 feet above the top of the well screen and only 7 feet bgs. Because of the shallow depth and improbability of bridging in the filter pack, the bentonite seal was placed directly on top of the 6/9 sand, to ground surface, and was not followed by a cement/bentonite seal above it.

Sitewide Groundwater Level Measurements

In conjunction with ASARCO, two rounds of groundwater level readings were taken on February 7, 2006, and October 19, 2006. Each measurement event included all new and existing monitor wells that could be accessed at the time. Measurements were obtained using an electric water level indicator, which allows measurements to the nearest 0.01 foot. Two surface water elevations were also measured on August 23, 2006, and October 19, 2006, on the Gila River. One location was from the State Route 77 bridge in Winkelman and the other location was from the railroad bridge on ASARCO property southeast of Tailings Impoundment AB/BC.

Groundwater Sampling Procedures

The selected monitoring wells (including the four new monitoring wells) were sampled in February 2006 and August 2006. Field personnel were accompanied by ASARCO Consulting, Inc. during their regular sampling event and collected splits from their samples. The staff sampling procedures for both events are described in the following sections.

Water-Level Measurements

Groundwater level measurements were collected before purging using an electric water level indicator, which allows measurements to the nearest 0.01 foot. The electric water level indicator probe was decontaminated before initial use, between monitoring well locations, and at the end of each work day. Groundwater level measurements were collected from marked measuring points or the top of the north side of the well casing where no measuring point had been predetermined.

Standard Well Purging

Monitoring wells were sampled using portable submersible pumps or disposable bailers and were purged before sample collection. A minimum of three well casing volumes of water were purged. Clean flexible tubing was used for groundwater extraction. Tubes were decontaminated before use in each monitoring well or new tubes were used for each monitoring well. Pumps were placed below the water table at an elevation to permit reasonable draw-down while preventing cascading conditions.

Casing volumes were calculated based on total monitoring well depth, static water level, and casing diameter. One casing volume was calculated as the volume of water within the casing before pumping.

It was most important to obtain a representative sample from the monitoring well. Stable water quality parameter (temperature, pH, and specific conductance) measurements indicated representative samples were obtainable. Water quality was considered stable when for three consecutive readings:

- Temperature range is no more than ±1°C
- pH varies by no more than +/- 0.1 pH units
- Specific conductance readings are within +/- 3% of the average
- Oxidation reduction potential (ORP) values are within +/- 10% millivolts
- Dissolved oxygen (DO) values are within +/- 0.3 milligrams per liter

Measurements were collected before the start of purging and at the end of purging each casing volume. If water quality parameters were not stable after five casing volumes, purging was to cease and be noted in the logbook, and groundwater samples were collected. The depth to water, water quality measurements, and purge volumes were entered on the field forms or in the field logbook.

If a monitoring well dewatered before three casing volumes could be purged, the monitoring well was allowed to recharge up to 80 percent of the static water column, and pumped again until parameters stabilized and a sample could be collected. If the monitoring well dewatered again before purging three casing volumes and collecting samples, the monitoring well was again allowed to recharge, and groundwater samples were collected.

Supply Well and Water Tap Purging

For samples collected from operating water supply wells, manifolds, or from a drinking water tap, the procedures varied from standard purging. If the water source was routinely used (continuously or several times throughout the course of a day), the tap would run for a minimum of 15 minutes before sampling. If the water source was not in routine use, the tap would run for a minimum of 30 minutes. During sampling, the flow rate was reduced to minimize aeration or splashing. Observed field parameters were recorded throughout the purging process.

Sample Collection

After field parameters stabilized, as described above, CH2M HILL collected water samples for laboratory analysis. Groundwater samples were collected from the sampling port using clean, EPA-certified sampling containers, preserved as necessary. To minimize aeration of the sample, the sample flow rate was reduced to approximately 100-milliliters per minute. This was done to minimize aeration.

Calibration of Field Equipment

Field equipment requiring calibration included a Horiba U-10 (a combination pH, electrical conductivity, turbidity, and temperature meter). The meter was calibrated before the start of work. Calibration was done in accordance with procedures and schedules outlined in the particular instrument's operation manual using Horiba U-10 Auto-Cal solution.

The turbidity meter on the Horiba U-10 seemed out of range and failed to recalibrate. Results of activities performed using this equipment were evaluated. This was documented and the task manager and QA/QC reviewer were notified.

Sample Containers and Preservatives

Clean, EPA-certified sampling containers were used for this project. Preservatives, if required, were added by staff in the field. The adequacy of preservation was verified by the laboratory upon receipt of the samples, and additional preservatives were added, if necessary. The containers, minimum sample quantities, field filtering requirements, required preservatives, and maximum holding times are described in the RI technical work plan.

Decontamination

All nondedicated equipment was decontaminated after each use as described below.

- Wash the equipment with nonphosphate detergent
- Rinse the equipment with tap water
- Rinse the equipment with deionized/distilled water

Equipment was protected from dust and allowed to air-dry. Decontaminated equipment was not allowed to touch contaminated surfaces.

Management Procedures and Documentation

Field Logbooks and Forms

As called for in the FSP, pertinent field activities for all tasks were recorded in bound field logbooks and boring log forms. All information was recorded in ink and errors were crossed out and initialed. Sampling activities were recorded in a bound field logbook. This logbook was intended to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project. The field logbook was maintained by each sampling team leader to provide a daily record of significant events, observations, and measurements during field investigations. Copies of all necessary field forms, logbooks, and select supplies were kept in the portable field box. Once the groundwater investigations were complete, these files were returned to the office for copying and filing. The field boring logs were transferred to final boring logs with well construction diagrams included (Appendix F) of this RI report.

Photographs

For any photograph taken, the following information was written in the field logbook:

- Time, date, location, and weather conditions

- Description of the subject photographed
- Name of person taking the photograph

Labeling

Each sample container was labeled with a sample identification number, date of collection, time of collection, case number if required, type of analysis, and preservatives. Sample identification numbers and locations (including blanks and duplicates) were recorded in the field logbook and field datasheet.

Sample Chain-of-Custody (COC) Forms and Custody Seals

Samples were placed in containers sealed with custody seals. Two custody seals were placed on each side of the shipping container (cooler). COC forms were generated using Forms II Lite for the collected samples, as applicable. COC procedures were followed as described in the RI technical work plan. When sent by common carrier, a bill of lading was used. Freight bill, postal service receipts, and bills of lading were retained as part of the permanent documentation.

Packaging and Shipment

Procedures used for sample packaging and shipment are described in detail in the RI technical work plan. The appropriate sample containers were placed upright in prepared coolers. Coolers were then packed sufficiently with ice to maintain the temperature of the samples below 4 degrees Celsius. The COC was placed in a resealable bag and set on top of the samples before sealing the cooler. The cooler lids were sealed with strapping tape, encircling the cooler several times.

Quality Control Samples

The QC samples were collected or prepared to assist in determining data reliability. These QC samples included field duplicates, field blanks, and laboratory QC samples for MS/MSD. The QC samples were collected immediately following and using the same procedures as the collection of the target sample. The location of QC samples, the type of QC sample, the description of each QC, and the sample collection procedures for each QC sample are described in the RI technical work plan.

Deviations from Groundwater Sampling Procedures

Winter 2006 Sampling Event

The actual monitoring wells sampled were determined during the final site reconnaissance, as some monitoring wells described in the RI technical work plan either did not exist, were determined non-representative, or unnecessary. Monitoring wells GW-01 and GW-02 samples were not analyzed due to unacceptably high pH levels and the need to further develop these wells. SM-2 was not sampled because ASARCO determined the monitoring well to be dry. H-7 was not sampled because the monitoring wellhead had been vandalized and the integrity of the sample may potentially be compromised. Hayden Park was not sampled because it did not have a water fountain. HWF-26 was sampled in place of HWF-25 because HWF-25 was not operating at the time.

Summer 2006 Sampling Event

The monitoring wells sampled during summer 2006 were based on the winter 2006 sampling event. Monitoring well GW-01(R) was sampled in place of GW-01. Samples from GW-01(R) and SM-2 were taken on two different days because of low yield—the monitoring well was evacuated (bailed dry) and needed to recharge overnight. Turbidity readings were unreliable or not recorded due to instrument calibration problems.

Containment and Disposal of Investigation-Derived Waste (IDW)

For the groundwater investigation and sampling task, the following IDW was generated:

- Drilling and Monitoring Well Installation
  - Used PPE
  - Soils cuttings and groundwater produced during drilling
  - Purged groundwater during monitoring well development
- Groundwater Sampling Events
  - Purged groundwater and excess groundwater collected for sample container filling
  - Decontamination fluids.

Used personal protection equipment (PPE) and excess well construction materials were also generated and were placed in a municipal refuse dumpster. These wastes were not considered hazardous and could be sent to a municipal landfill.

Task 3e—Air Investigation and Dust Sampling

The purpose of the air investigation is to further characterize the concentrations of contaminants from the site at discrete areas within Hayden and Winkelman. This was conducted by installing particulate matter (PM) at 10 microns (PM_{10}) and meteorological stations in Hayden and Winkelman. A secondary purpose is to evaluate metal concentrations in dust samples in residential homes.

Air Investigation

This investigation involved collection of meteorological monitoring data and PM_{10} samples from the air sampling monitoring network and laboratory analysis for PM_{10} samples and individual metals on the collected filters. The monitoring network consists of two monitoring stations. One monitoring station is located at the Town of Hayden Maintenance Yard and the other at the Winkelman High School. Although the area seems to be in compliance with National Ambient Air Quality Standards (NAAQS) for PM_{10} and lead, the PM may contain elevated concentrations of several elements of concern including arsenic, cadmium, chromium, copper, lead and zinc.

Monitoring Station Locations

Town of Hayden Maintenance Yard and Winkelman High School were selected as locations for the air monitoring stations.

Each monitoring station was installed to comply with applicable portions of the state and local Air Monitoring Station Requirements (40 Code of Federal Regulations [CFR] 58). The Hayden monitoring station was placed on the roof of the Town of Hayden Maintenance Yard building. The Winkelman monitoring station was placed on the roof of the Winkelman High School gymnasium. In accordance with the FSP and EPA guidelines (*Ambient Monitoring Guidelines for Prevention of the Significant Deterioration (PSD*), EPA 450/4-87-007 (EPA, 1987) for PM_{10} air samplers, the inlet of both monitoring station locations is 6.5 to 49 feet above ground level. A minimum of 6.5 feet separates the monitoring stations at both locations from walls and parapets. The monitoring stations are located away from obstacles, such that the distance between obstacles and the sampler is at least twice the height that the obstacle protrudes above the monitoring station. Airflow around both monitoring stations is unrestricted in an arc of at least 270 degrees.

Monitoring Station Installation

A Rupperecht and Patashnick Co., Inc. Partisol-Plus Model 2025 Sequential Air Sampler (for collection of PM_{10} samples) was installed at both locations. Each monitoring station was placed level and secured to its stand, which was secured to the roof. A platform was constructed atop the Town of Hayden Maintenance Yard building because of the building's sloped roof. The stand used to support the monitoring station at this location is secured to the platform. A ladder with harness system was installed to allow safe access to the monitoring station.

In accordance with the FSP, rainhoods and the ambient temperature sensors were installed on the monitoring station enclosures. The sample tube, first stage inlet, and PM_{10} inlet were also installed. Each unit was connected to electrical supply.

A meteorological station is co-located with each PM_{10} station. A wind vane/anemometer was also installed at each site to measure wind speed and direction. The wind speed and direction transmitter was secured on a vertical pipe adjacent to the monitoring station and connected to Partisol–Plus data logger using a RS-232 connector. Temperature and relative humidity data are recorded by the monitoring stations. These monitoring stations have been collecting data since August 2006.

A rain gauge was installed at the Winkelman High School bus yard area for collection of area precipitation data. Precipitation levels are being recorded by local Winkelman High School personnel after rain events. The monitoring stations began collecting meteorological data in August 2006.

Sample Collection

Monitoring stations are programmed to collect samples for a 24-hour period from midnight to midnight. Sampling is planned for a period of 1 year. One 24-hour sample is collected every sixth day in accordance with the RI technical work plan.

Site visits are frequently made to collect the filter samples and verify continuous and uninterrupted operation of monitoring stations. When monitoring station operations have been interrupted, personnel have identified system errors and placed the impacted monitoring station back to normal operating status.

Pre-weighed 47 mm filters are received from the EPA assigned laboratory (CHESTER LabNet) and transported to the site for sampling. New filters are removed from their containers and placed inside a filter cartridge. The filter number, as provided by the laboratory, is marked on the filter cartridge. The cartridges are then loaded into the feed magazine in reverse order of when they will be sampled. The magazine is reconnected to the monitoring station and the filter numbers are entered into each monitoring station filter list.

Every sixth day a new filter has ambient air drawn though it at 16.7 liters/minute for 24 hours. Once sampling is complete, the filter cartridge is transferred to a collection magazine and a new filter cartridge is transferred to the sampling position. Sampled filters are collected during Site visits, which occur at least once every two weeks, and shipped to CHESTER LabNet for analysis. Laboratory selection caused delays between the installation of the monitoring stations and the collection of samples, but the PM_{10} monitors have been collecting data since November 2006.

During site visits, meteorological data collected by the monitoring stations is downloaded to a handheld computer. The data is then uploaded from the handheld computer to a desktop computer for use and storage.

In accordance with the RI technical work plan, samples will be collected from the monitoring stations for a period of 1 year.

Sample Management

Collected samples have been shipped via FedEx to CHESTER LabNet for analysis of PM_{10} and TAL metals, in accordance with the RI technical work plan and FSP. Samples are containerized and sent with a COC record that includes sample identification, location, sample date, particle size, and requested analysis. Flow volumes are also provided to the laboratory. A transmittal is also sent to CHESTER LabNet identifying the samples and the date they were shipped.

Deviations from Work plan and FSP

This section describes deviations from the RI technical work plan and FSP for air monitoring procedures at the Town of Hayden Maintenance Yard and Winkelman High School monitoring stations at the site.

Sample Collection

The FSP stated that the sampled filters will be collected and shipped in a filter cassette magazine inside a cassette magazine metal transport container. Shipment of filters in this fashion was determined to be unnecessary. Filters are placed into lightweight plastic containers for shipment.

Indoor and Attic Dust Sampling

This section describes indoor dust sampling activities conducted at 22 homes in Hayden and Winkelman. This work was performed in accordance with the RI technical work plan and Addendum #2, Task 3e—Air Investigation and Dust Sampling. This task involved performing laboratory analyses of samples collected from 18 sample locations in Hayden and 4 sample locations in Winkelman. Sample homes were selected based on concentrations of arsenic in soil detected during residential surficial soil sampling activities in January and February 2006. The sample locations were selected to generally include several homes where relatively low, medium, and high arsenic concentrations were found in soils at the same location.

Indoor dust sampling was conducted on February 23, 2006, and May 17 and May 18, 2006. EPA provided oversight throughout the sampling event.

Sample Location Selection

Sample locations were selected within Hayden and Winkelman based on the range of FPXRF arsenic concentration from residential surficial soil sampling activities. Three groups of contaminant concentration levels were established from which sample locations were chosen. Group 1 contamination levels represented locations where arsenic was detected in soil at concentrations exceeding 80 ppm. Group 2 contamination levels represented locations where arsenic was detected in soil at concentrations ranging from 40 ppm to 80 ppm. Group 3 contamination levels represented locations where arsenic was detected in soil at concentrations less than 40 ppm. Sample locations were selected from each group to provide coverage over the range of soil concentrations. Homes were chosen for sampling only if a signed access agreement was obtained from the property owner or tenant. Property owner information was based on efforts from the residential soil sampling effort.

Sample Collection Procedures

This section describes procedures for collection of indoor and attic dust samples.

Indoor Dust. In accordance with the FSP, the indoor (occupied area) dust samples were collected from floors and other horizontal surfaces with preference given to areas (that is, high window ledges, along baseboards, and behind furniture) that tend to collect dust. Dust was collected from surfaces by means of vacuum-induced suction. A EURO-PRO Model EP187 handheld vacuum with HEPA filter was used for dust sample collection on February 23, 2006. A Sanitaire System Pro Model S107 handheld vacuum with dedicated filter bag was used for dust sample collection on May 17 and May 18, 2006. Dust sampling personnel donned nitrile gloves and a dust mask during sample collection. Dust was collected from the indoor area of each home until the dedicated filter was visibly covered with dust. Once a sufficient volume of sample was collected, the dust was transferred to a sample jar. An open sample jar was centered on a dedicated sheet of paper and the vacuum was disassembled above the jar. Once disassembly was complete, the filter was removed from the vacuum and placed into the jar. Dust accumulated on the paper was funneled into the jar. The jar was capped for storage and submitted for analysis of TAL metals.

Attic Dust. Attic dust samples were collected at all residences where attics were accessible (11 of 22 homes). A ladder was placed under the attic entrance to allow access to the attic for dust sampling. A tarp was placed under the ladder to catch material disturbed during attic access. Dust sampling personnel donned nitrile gloves, tyvek suits, and a dust mask before entering the attic for sample collection. One staff person entered the attic to collect the sample while a second person secured the ladder and distributed equipment for sample collection. A flashlight was typically required to illuminate the attic for sampling point selection. Each sampling point chosen was the closest accessible area to the access hatch that had an undisturbed accumulation of dust.

A dedicated sheet of paper was placed on the attic floor at the sampling point. Dust was swept onto the paper from the surrounding surfaces using a dedicated brush. The dust was then funneled into a dedicated, re-sealable plastic bag. Collection continued in this manner until the bag contained a dust thickness of approximately two inches. When surface condition did not permit the use of a dedicated brush, dust was collected and placed into the bag using a plastic putty knife. The bag, and when allowable, the sample point, were labeled with the sample number using a permanent marker or paint pen. Once a sufficient sample was collected, the sample was homogenized and transferred to a sample jar. An open sample jar was centered on a dedicated sheet of paper and the dust was poured from the bag into the jar. Dust accumulated on the paper was funneled into the jar. The jar was capped for storage and analysis of TAL metals. TOC analysis was provided only on those samples where a sufficient volume of dust was collected.

Field duplicate samples were collected by evenly splitting the collected dust between two sample jars. Only loose dust not collected on the filter was separated for field duplicates. Attempts to remove dust from the filter for purposes of field duplicate collection led to sample loss.

Based on direction from EPA, two equipment blank samples were collected to verify that contamination was not introduced to samples during collection. The equipment blank sample consisted of a subset of two samples. The first sample was collected directly from a previously undisturbed container of 100 mesh sand by opening the container and pouring the sand into a sample jar (this analysis was to confirm "baseline" soil quality). The second sample of 100 mesh sand was extracted from the container using the vacuum. An open sample jar was centered on a dedicated sheet of paper and the vacuum was disassembled above the jar. Once disassembly was complete, the filter was removed from the vacuum and placed into the jar. Sand that collected on the paper was funneled into the jar. The jar was capped for storage and analysis. This approach was intended to confirm that the vacuum itself was not contributing to increased metal concentrations to the sampler.

To ensure sample size, a larger quantity of dust was collected from attics where field duplicate samples were taken. Three times the normal attic dust volume was collected for the one MS/MSD sample collected.

Decontamination. Decontamination of the vacuum used for the indoor dust sample collection was performed before each use. Individual vacuum parts were cleaned using an Alconox solution and brushes. Parts were rinsed with deionized water and dried with clean paper towels.

Decontamination of attic dust samples collection equipment was performed before each use. Collection equipment was cleaned using an Alconox solution, deionized water, and paper towels.

Sample Management. All dust samples were handled in accordance with the FSP. Sample jars were labeled with the sample ID, date, time, appropriate analysis (TAL metals for the polyethylene jar and TOC for the glass jar), case number, and client ID. A custody seal was placed over each sample container cap and the jars were placed into coolers containing double-bagged ice and a temperature blank. A COC was then placed inside each sample cooler and custody seals were affixed to the outside of each cooler before shipping. The coolers were then shipped via FedEx to the EPA Region IX Laboratory for TOC analysis. Samples for TAL metals were sent to the CLP laboratory designated by EPA (Liberty Analytical in Cary, North Carolina).

Task 3f—Conduct Ecological Investigation

A detailed discussion on the procedures used for the ecological investigation can be found in Appendix I in this RI report.

Task 3g—Geotechnical Evaluation

A detailed discussion on the procedures used for the geotechnical evaluation can be found in Appendix G in this RI report.

Task 3h—Surveying and Mapping

To improve accuracy and efficiency and reduce RI costs, handheld GPS units were used to establish the locations of sampling points. These units will reduce data gaps, reduce land surveying costs, eliminate post collection data entry, and standardize data collection.

A Trimble GeoXT handheld GPS unit was used during the field effort. This high-end resource grade GPS mapping system was capable of collecting post processed differential GPS data with specified accuracy of .5-meter or sub-meter root means square. This unit also employed Everest Multipath Rejection Technology, which reduces the chances of positional errors due to multipath. For each sampling location, a minimum of six satellites were locked on the GeoXT to ensure accuracy.

Task 3i—Investigation Support Activities

Precleaned and quality-assured sample containers that met EPA specifications were used for all samples. All containers were cleaned and certified by the vendor to be free of the analytes of concern for this project. No sample containers were reused. Preservatives, where required, were added to sample containers by the field team before bringing the containers to the field. The adequacy of preservation was verified by the laboratory upon receipt of the samples and additional preservatives were added where necessary. Generally, samples submitted for laboratory analysis were placed in a cooler with ice and proper COC documentation. All sample containers were managed as outlined in the FSP.

Field Variances

As conditions in the field varied, it was necessary to implement minor modifications to sampling specifics and procedures as presented in the RI technical work plan and subsequent FSP. When appropriate, the EPA Quality Assurance Office was notified and a verbal approval obtained before implementing the changes. Modifications to the approved RI technical work plan are documented in the sampling project report.

Sample Documentation and Shipment

As conditions in the field varied, it was necessary to implement minor modifications to sampling scope of work and procedures as presented in the RI technical work plan and subsequent FSP.

Field Notes

Field notes for site sampling consisted of logbooks, COC forms, preprinted surficial soil sampling forms, preprinted monitoring well sampling forms, and photographs.

Field Logbooks

All sampling activities were recorded in a bound field logbook. Entries were dated, legible, written in permanent ink, and contained accurate and inclusive documentation of project activities. Language was objective and factual. Entries included (as applicable):

- Names of all personnel involved in the field activities
- Date of work
- Description of work performed
- General description of weather conditions
- Field instruments calibration information
- Subcontractors present
- Potential responsible party representatives names
- Visitors to the site
- Reference to any photographs taken
- Signatures of persons making log entries
- Location of each sampling point
- Date and time of sample collection
- Observations of sampling procedure
- Type of blank collected and method of collection
- Duplicate and matrix spike sample locations

- Legible corrections, which consisted of single lines through the error, signed and dated by the person making the correction
- Name, address, and telephone number of the contracted analytical laboratory
- Field observations and descriptions of problems encountered or changes made to the original plan

Photographs

For each photograph taken, the following information was either written in the logbook or recorded in a separate field log form:

- Time, date, location, and weather conditions
- Description of the subject photographed
- Name of person taking the photograph

Labeling

Each sample container was labeled with an EPA Region IX case number, CLP case number, sample identification (sample location), CLP identification (sample number), date and time of collection, type of analysis, and preservative (where applicable). All sample numbers and locations (including blanks and duplicates) were recorded in the field logbook.

Sample Chain of Custody Forms and Custody Seals

Samples shipped to the laboratory were placed in containers sealed with custody seals. One or more custody seals were placed on each side of the shipping container (cooler). COC forms were filled out for all samples collected.

COC procedures were followed as described below to accomplish this task. The COC documentation included:

- Information from each sample label, including the sample identification number, to allow correlation of the sample with the sample location and depth (if applicable)
- Date and time the sample was collected
- Samplers' signatures
- Identification of any preservatives used (if applicable)
- Requested analytical method and turnaround time for analysis
- Any special instructions for the laboratory (for example, MS/MSD, dilution may be necessary)

Additional information on the COC included the case and/or DAS (Delivery of Analytical Services) number, organic and inorganic sample number, date shipped, carrier name and air bill number, laboratory destination, and address and phone number. Each COC form was signed by the sampler and by the laboratory official once the samples had been delivered. The COC was included with each sample it represented until such time as the samples had been delivered to the laboratory.

Management of Investigation Derived Waste

This section describes the procedures used for management of Investigation Derived Waste (IDW).

Equipment Decontamination

This section discusses the decontamination procedures used for each type of tool used during this RI.

Heavy Equipment

A separate decontamination facility was established to decontaminate heavy equipment. Contractors who provided heavy equipment were directed to install a decontamination pad. Heavy equipment decontamination areas each consisted of a concrete pad and curbing or other containing structure, accompanied by a sump to contain wash water. IDW was managed as outlined in the FSP.

Sampling Equipment Decontamination

Sampling equipment not dedicated to a single location was decontaminated between sampling locations. Decontaminated equipment was not allowed to touch potentially contaminated surfaces after drying and before use. Where feasible, decontaminated equipment was covered or placed separate from the main work area to prevent accidental contact with contaminants.

Personnel Decontamination

Procedures for personnel decontamination are described in the Health and Safety Plan.

Management and Disposal of Investigation-Derived Waste

During implementation of the technical work plan, different types of potentially contaminated IDW were generated that included the following:

- Used PPE.
- Disposable sampling equipment.
- Decontamination fluids.
- Purged groundwater, well development water, purged aquifer test water, and excess groundwater (collected for sample container filling).
- Drill cuttings and drilling fluids.
- IDW was managed as outlined in the FSP.
- Used PPE and disposable equipment were double-bagged and placed in a municipal refuse dumpster. These wastes were not considered hazardous and were delivered to a municipal landfill. Any PPE and disposable equipment that was to be disposed of, but which could still be reused, was rendered inoperable before disposal in the refuse dumpster.

- Decontamination fluids generated during the sampling event consisted of deionized water, residual fluids containing contaminants, and water with nonphosphate detergent. The volume and concentration of the decontamination fluid was sufficiently low to allow disposal at the site or sampling area.
- Well development water was contained and sampled as specified in the FSP.
- Upon approval from the regulatory agencies and property owners, purge water was left onsite.

Excess soil, drilling fluids, and decontamination fluids generated from drilling for groundwater monitoring wells and exploratory borings were contained, labeled, and disposed of properly, as described in the appropriate section of this report.